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IS THE MILITARY BUDGET OUT OF BALANCE?

Occasionally one reads or hears complaints about the status of manpower, logistics and support in the development of the Department of Defense budget. It is felt that the United States spends too much to buy fancy new equipment, and not enough to man and support it adequately. This feeling is based on two observations. First, readiness is perceived to be so low that spending more on it must be a good buy. Second, the political process and the timing of expenditures conspire to make hardware easier to sell and support easier to cut.

This is an important matter. If it is true, the U.S. is getting less defense for its money than it might be. Improving the level of public discussion requires the development of empirical evidence to move beyond the realm of casual observation and speculation. The analytic issue is whether it is cheaper to get additional defense capability by buying more forces or by spending more to keep smaller forces working.

This paper addresses this issue by examining four case studies. The analyses behind the case studies were performed at the Center for Naval Analyses during the last twelve years. Thus, they all examine Navy systems. I see no reason to believe that Air Force or Army analyses would yield different results. Each of the analyses focuses on

the production of weapons system availability by application of additional support resources.

The case studies look at the value of spare parts and people in producing equipment readiness. Specifically, they address the payoff to additional spare parts to repair ships, fixed-wing aircraft, and helicopters, and to additional personnel aboard surface combatants. For each of these four examples I will describe the research being drawn on, display the quantitative relationship between support expenditures and system availability it derived, and compare the cost of buying availability via suport with the cost of availability implicit in the life-cycle cost of equipment.

This approach cannot yield a definitive answer to questions about budgetary balance for four reasons. First, it is based on only four data points. Second, it incompletely treats cases of partial capability. A ship or airplane with a broken part can successfully perform some missions. It couldn't have if it had not been bought. Third, this analysis ignores issues of employment and tactics. Is it really the same to have twice the forces that work half the time as half the forces that work all the time? Probably not, but the direction of bias is not altogether clear. Here I assume the two are equivalent. Finally, I am discounting the argument that support can improve after we get the equipment, so let's get the hardware now and beef up support when a crisis comes. Support isn't something that can be improved that

quickly. Parts often take a year to get from the manufacturer. Trained people take longer. If we are not prepared to fight with what we've got, we are more likely to have to.

In any case, the purpose of this paper is to see if there are gross imbalances between support and procurement levels, not to make close calls. My methodology should be adequate for this purpose. I have tried to be conservative in describing the payoff to increased support. Nonetheless, the general message of the analysis is that we'd be better off if we bought less hardware and supported it more. Let us now turn to the four case studies.

Repair Parts for Shipboard Equipment

In order to expeditiously repair broken equipment, every U.S. Navy ship is authorized to carry a selected set of repair parts on board. If a failure occurs and the proper part is not on board, repair will be delayed, perhaps substantially, while the part is ordered from some distant point. It has been the Navy's policy to stock all parts that are expected to fail at least once every four years aboard ship and not to stock those that fail less frequently.

Analysis of failure rates aboard Knox-class frigates showed that this policy leads to 69 serious failures per month that are not covered

by on-board stock.[1] A serious failure is one associated with a part that is necessary for a ship to perform fully at least one of its primary missions.

The Shipboard Parts Allowance Policy study examined the readiness implications of changing the stocking rules. In particular it looked at the effect of stocking critical parts if they failed at least once every ten years. As table 1 shows, this policy shift could be expected to cut serious uncovered failures by more than half at a marginal cost of $400,000.

TABLE 1

READINESS AND SHIP REPAIR PARTS

	Expected Serious Failures Per Month	Life Cycle Cost ($M)	Disabling Failure Days Per Month
Current stocking policy	69	1	17
Modified policy	32	1.4	8

Of course not all failures that cause some mission-related performance degradation are really debilitating. Examination of data on serious failure shows that roughly five percent of them cause the complete inability to perform more than one primary mission. For our

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[1]CNR 12, Shipboard Parts Allowance Policy, Bagby, James L., Cdr., USN, July 1981.

purposes, let us treat this five percent as causing complete unavailability of the ship and all other failures as harmless, clearly a conservative assumption. Further, let us assume that repairs requiring an off-ship part only take five days on average, even more conservative. As the last column of table 1 shows, the modified policy cuts nine days from the expected number of disabling-failure-days per month. Nine days is thirty percent of a month. This is like buying thirty percent of a ship for $400,000, or a ship-equivalent for $1.33 million. The life-cycle cost of this kind of ship is roughly $500 million, 375 times as much.[1] To the Navy's credit it is adopting the modified policy.

Aircraft Spare Parts

An early analysis of the relationship betwen support resources and equipment was completed in 1970.[2] It used a production-function approach to the readiness of tactical aircraft. the analysis used monthly observations of aircraft at the squadron level. Both deployed and training squadrons were included. "Ready hours," the number of hours operationally ready per month by planes in the squadron, was the measure of output. Three inputs were included in the analysis: the

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[1]This may be an overstatement. Reports of disabling failures show somewhat less downtime than table 1. Also sometimes failures are simultaneous, which hasn't been accounted for. Still, 375 is a very big factor.

[2]INS Study 32, A Study of Aviation Resource to Readiness Relationships, S. Scott Sutton et al., June 1970.

number of planes per squadron, repair personnel and spares. Constant elasticity of substitution production functions were estimated.

Table 2 shows the results for F-4B aircraft. Holding costs constant, readiness could be increased 40 percent by removing one plane from the standard size squadron and by using more spare parts. This result held for the other aircraft types analyzed as well. One interpretation is that when parts are not available, aircraft will be cannibalized to provide them. It seems to be cheaper to holds parts in bins than to hold them configured as aircraft.

TABLE 2

CONSTANT COST TRADE-OFFS FOR THE F-4B

	Squadron Size	Spares ($ thousands)	Ready Hours (per month)
Actual	12	306	4229
Optimum	11	383	5963

Helicopter Parts

This recently completed analysis of a new helicopter is not one where additional trade-offs of force levels for support would seem to be

a good buy.[1] It is a hard-to-support system. It will be operating from ships in detachments of one or two. Thus, it will be difficult to pool parts' demands. In addition, it has an unusually high availability goal, making further improvements difficult.

We used a multi-echelon inventory model to choose the location of spare parts to maximize availability for a given level of expenditure. We found that the ambitious availability goal could be achieved. We then adapted the model to examine trade-offs between more parts and more helicopters at high availability levels. Illustrative results are shown in table 3. It shows two ways of getting 77 available helicopters. A marginal shift to higher availability and a lower force level could save $4 million.

TABLE 3

MORE PARTS VS. MORE HELICOPTERS

	Base Case	Alternative
Number of helicopters	96	95
Availability	80%	81%
Available helicopters	77	77
Savings from base case		
Procurement		$11M
Parts		-7M
Net savings		4M

[1]CNS 1171, Logistic Support of LAMPS MK III, Evanovich, Peter, forthcoming.

Shipboard Manning

Spare parts are not the only support resource that can be related to weapons system availability. In 1977 we completed an analysis of shipboard manning and readiness.[1] Readiness was measured by the amount of mission degrading equipment downtime aboard 91 surface combatants over a period that averaged about three years. Regression analysis was employed to relate equipment condition to the number and quality of men responsible for maintaining the equipment. Quality was measured by indicators such as education, test scores, experience, pay grade, and training. Six occupations were examined. The analysis took account of differences in ship age, operating tempo, and type of equipment.

Table 4 shows some illustrative results for boiler technicians aboard FRAM destroyers. The 600 lb. steam plants on these ships are relatively reliable, and, hence, less influenced by crew characteristics than other, touchier systems. Boilers are a good choice for an example because when a ship can't steam it can't perform any primary missions.

Using the same approximation as was used in the shipboard parts example, that five percent of mission degrading downtime is disabling, we found that one additional boiler technician was associated with 43 more hours of availability per year. This implies a cost of $750 per

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[1]CNS 1090, Crew Characteristics and Ship Condition, Horowitz, Stanley A. and Allen Sherman, CDR, USN, March 1977.

TABLE 4

	Additional Availability (hrs/yr)	Cost per year ($)	Cost per Hour of availability ($)
Man	43	32,000[a]	750
Ship	8,760[b]	26,000,000[c]	3,000

[a]Includes amortization of training costs.

[b]Of course this is an overstatement. No ship is available all the time.

[c]All costs are in FY 1982 dollars. We aren't buying FRAM destroyers anymore. This is an estimate of the annual cost to amortize our purchase and operate the ship if we were.

additional hour of availability. This is a quarter of what we pay for an hour of availability when we buy an additional ship.

Conclusion

The four case studies presented here leave one with the impression that readiness is short-changed at the budget table. Perhaps this is due in part to the inability of the sponsors of support to justify their requests in terms that appeal to decision makers. At best, logisticians try to explain their requests by noting what under-funding will do to their fill rates. The manpower community might refer to the reenlistment rate or the petty-officer shortfall. These approaches beg for, and often get, the response: so what! What will that mean for our

ability to beat the Russians? This response is unfair, most procurement requests don't answer this question very well, but it is quite natural. The war-fighting implications of support just don't seem as obvious as those of shiny new equipment.

The purpose of this paper has been to show that support can be evaluated on the same yardstick as procurement. It appears to be very much in the interest of the logistics and manpower communities to insure that such comparisons are made. The task of logistics and manpower researchers is to develop the tools for making them on a routine basis. If they are successful we will spend a larger fraction of the defense budget on support and our defense posture will be improved.